Griffith 2007.11.14

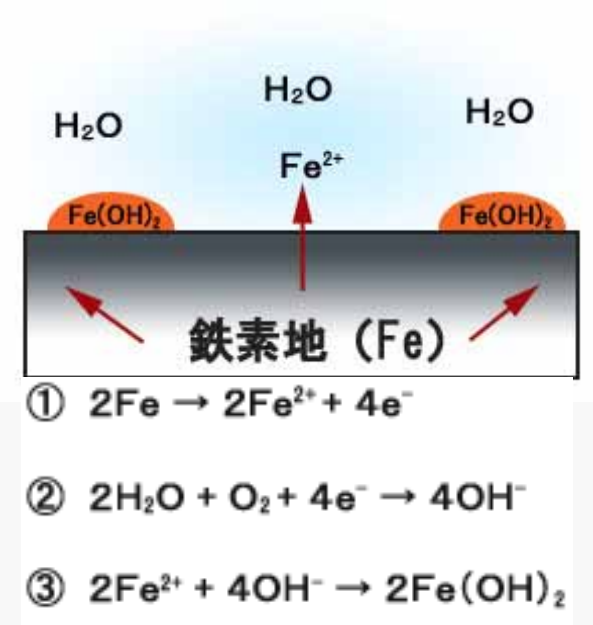
Bridge Management System and Maintenance of Bridges

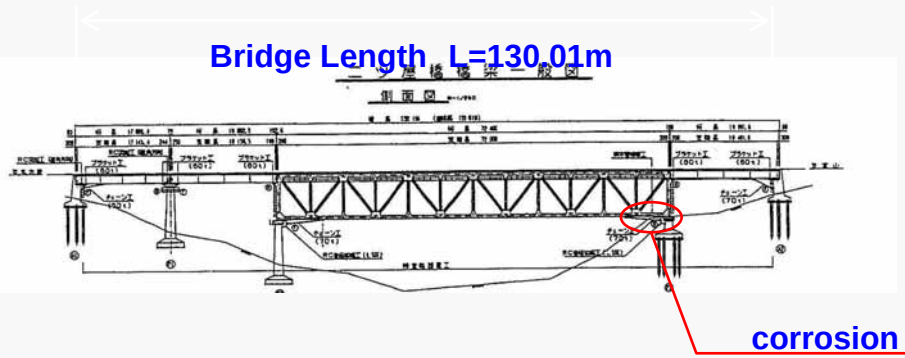
6. Corrosion and anti-corrosion measure

Organized by
Centre for Infrastructure Engineering and Management
&
School of Engineering
Griffith University Gold Coast Campus

6. Corrosion and anti-corrosion measure

1. Corrosion of steel bridges and corrosion map
2. Corrosion protection
3. Painting and re-painting
4. Thermal spray
5. Weathering steel bridge



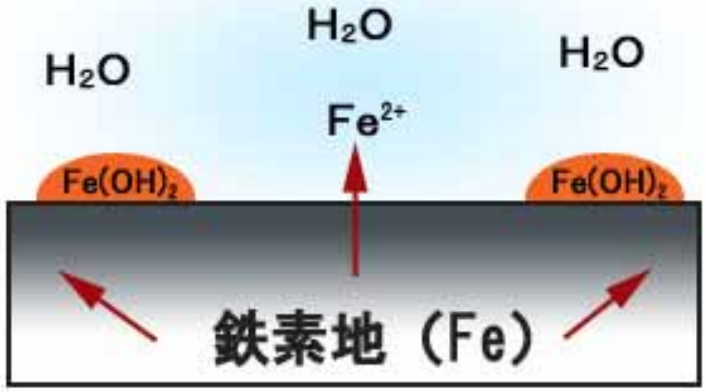


Mechanism and anti-corrosion measure

1. Off from O_2 and H_2O
   Paint
2. Zinc or Zinc-Al thermal
   spray coating

2. Cathodic protection

3. Weathering steel
   Cu, Cr, Ni, etc.



① $2Fe \rightarrow 2Fe^{2+} + 4e^-$

② $2H_2O + O_2 + 4e^- \rightarrow 4OH^-$

③ $2Fe^{2+} + 4OH^- \rightarrow 2Fe(OH)_2$

Mechanism and anti-corrosion measure

1. Off from O_2 and H_2O

   Paint

2. Zinc or Zinc-Al thermal spray coating

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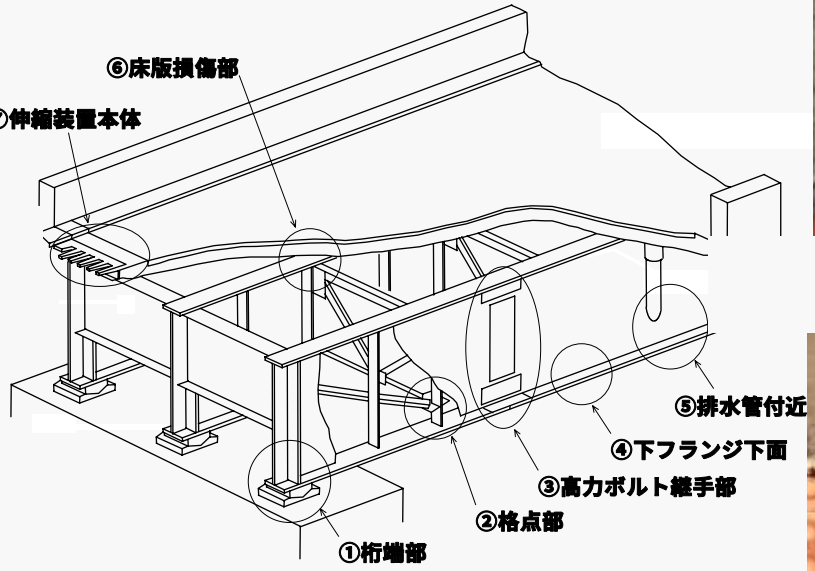
3. Weathering steel

   Cu, Cr, Ni, etc.

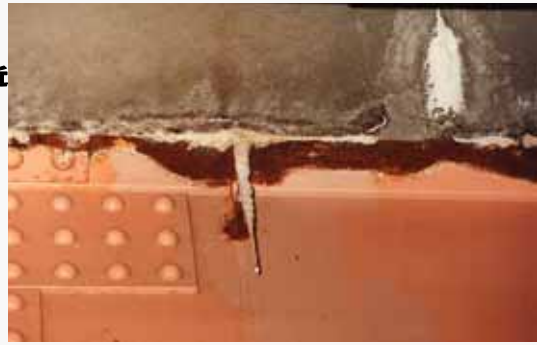
Corrosion Map (Plate Girder)

Shoe and Girder End



Drain

Panel Point



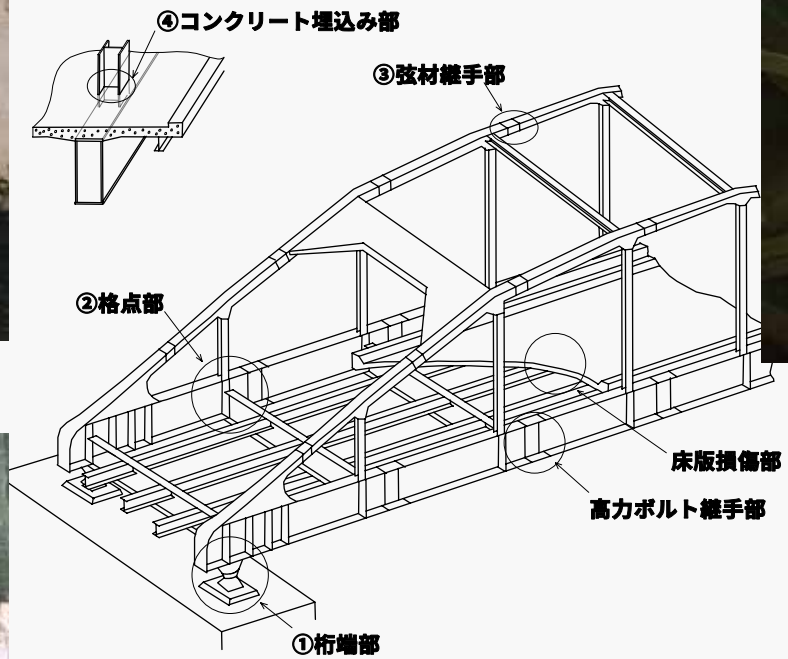
Bolted Joint

Lower Flange

Expansion Joint

Corrosion Map of Langer Bridge

Girder End



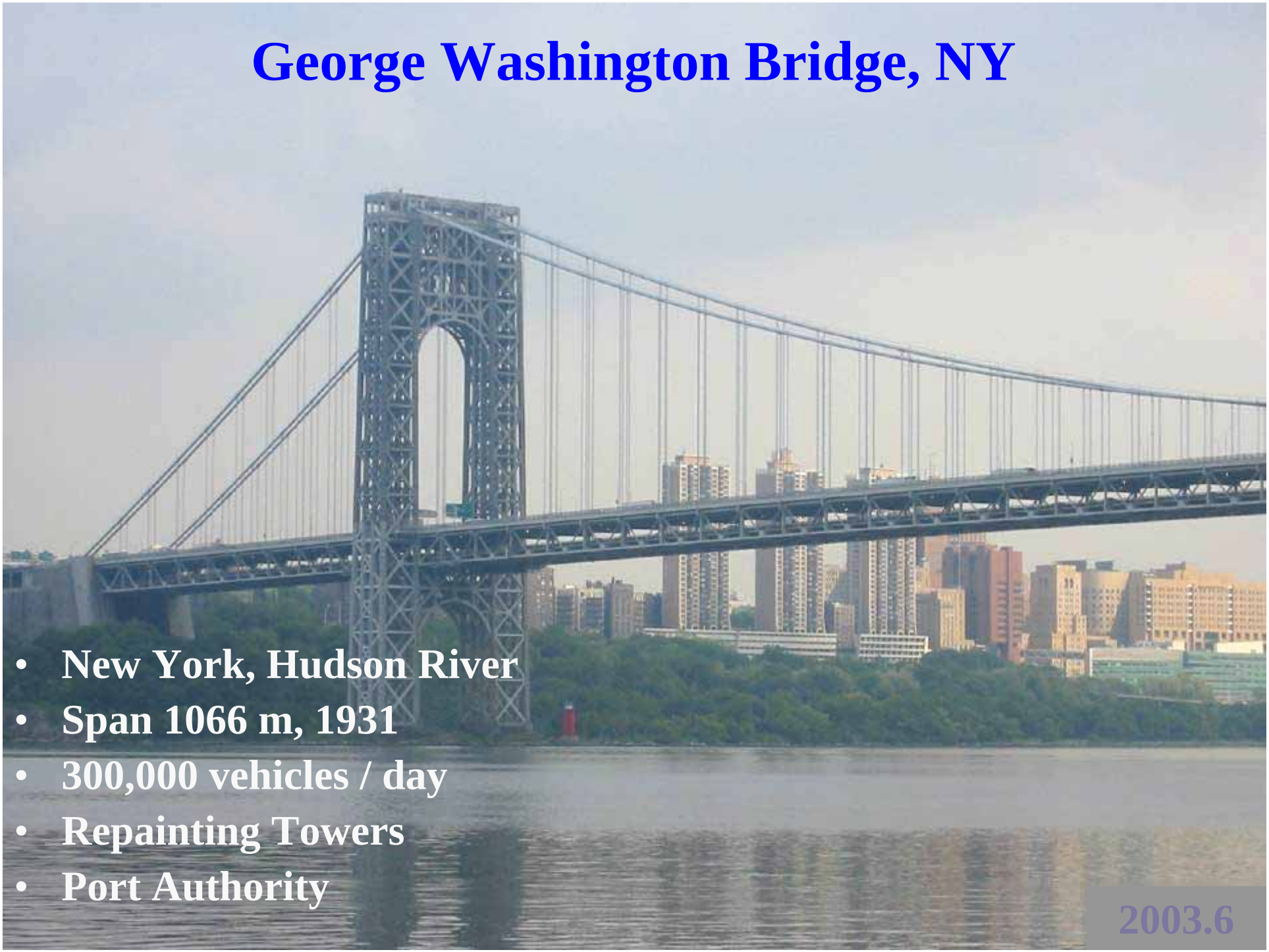
Panel Point

Panel Point

Joints

Steel and Concrete

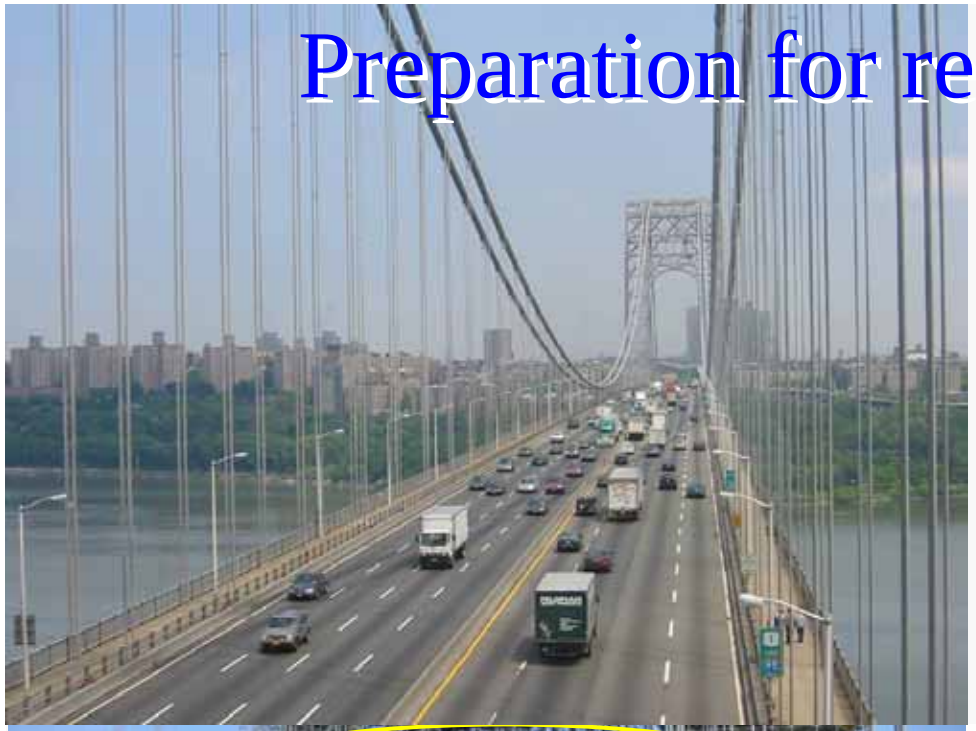
George Washington Bridge, NY



- New York, Hudson River
- Span 1066 m, 1931
- 300,000 vehicles / day
- Repainting Towers
- Port Authority

2003.6

Preparation for re-painting towers



Protective Shielding Platform

Paint Removal and Surface Preparation

Structural Steel, Steel Conduit, Steel Electrical Boxes and Panels, Weathering Steel

- SSPC-SP10 “Near White” blast clean
- Organic zinc rich primer
- Epoxy intermediate coat
- Aliphatic Urethane finish coat

Protective Shielding Platform

Tower base, equipments

Waste bins

Protective shielding

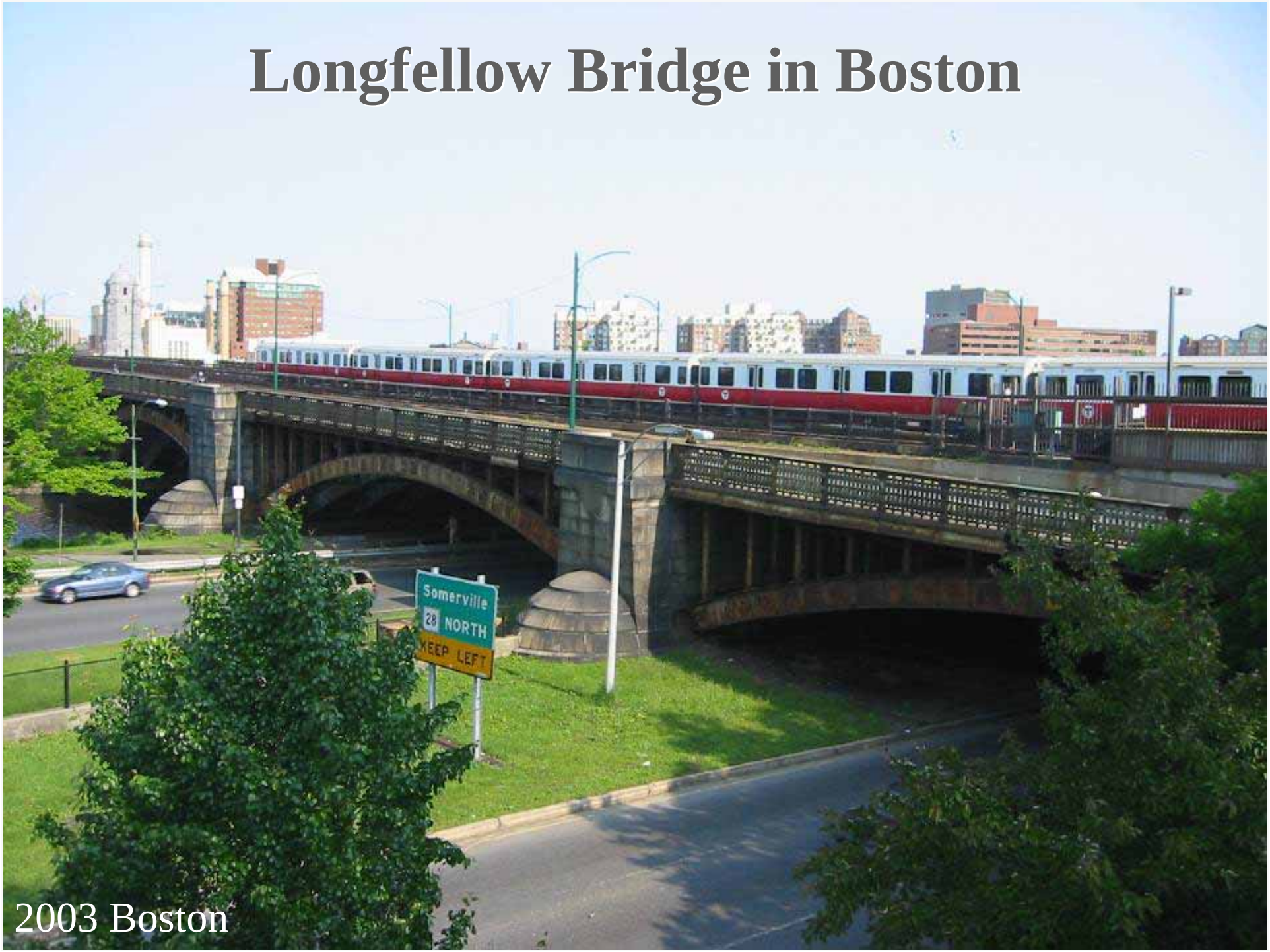
Before and after blasting and painting

Inside of tower base

Steel surface before and after blasting

Steel surface before and after blasting and painting

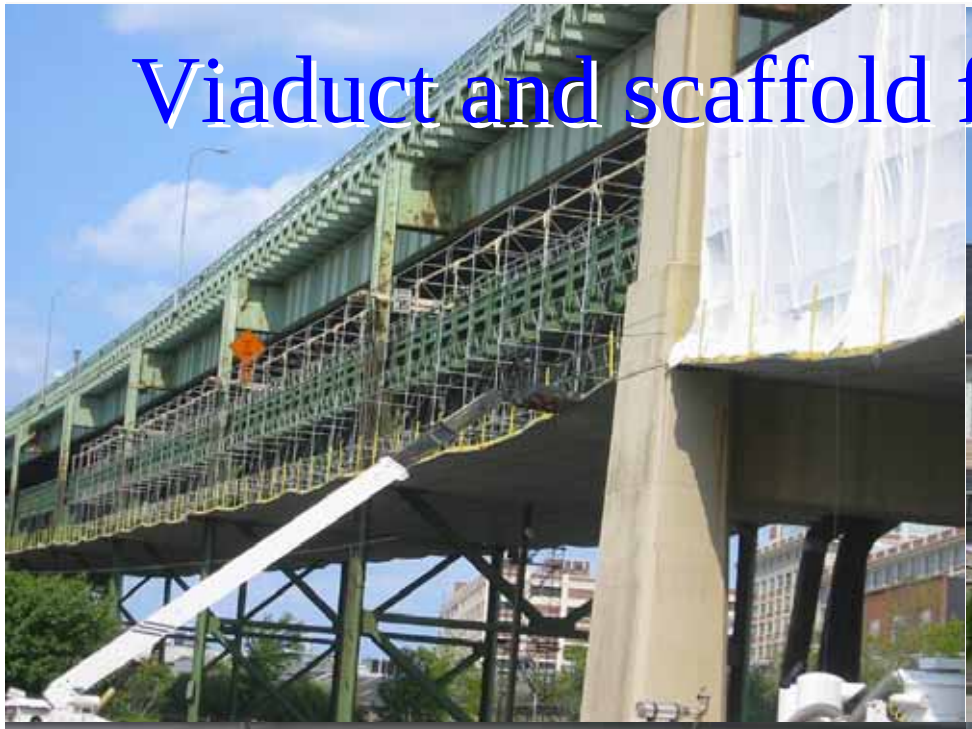
Longfellow Bridge in Boston



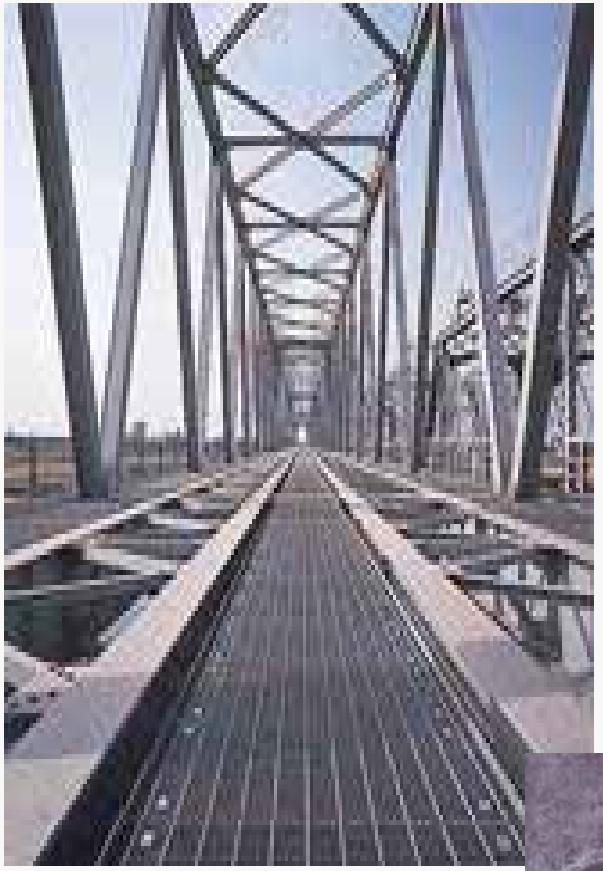
2003 Boston

Corrosion and test paint?

Viaduct and scaffold for repainting, Boston



Zinc coated structures



Zinc coating for large structures

Process of Zinc Coating

Process

sturcture

Remove oil

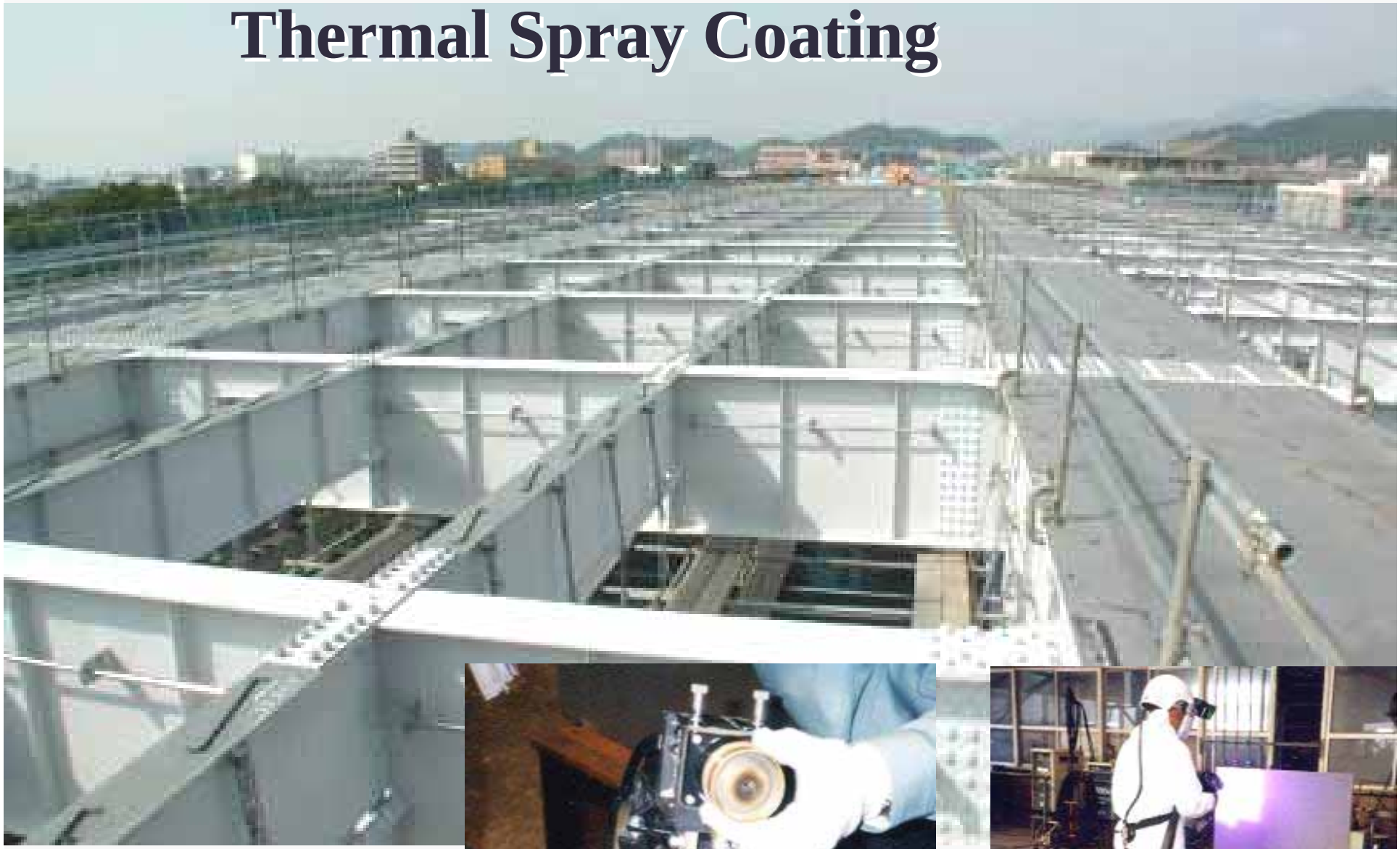
Washed by acid

Zinc coating

Surface treatment

Finishing process

Thermal Spray Coating



Application to New Urban Elevated Highway

Fukuoka Kita-Kyushu Expressway

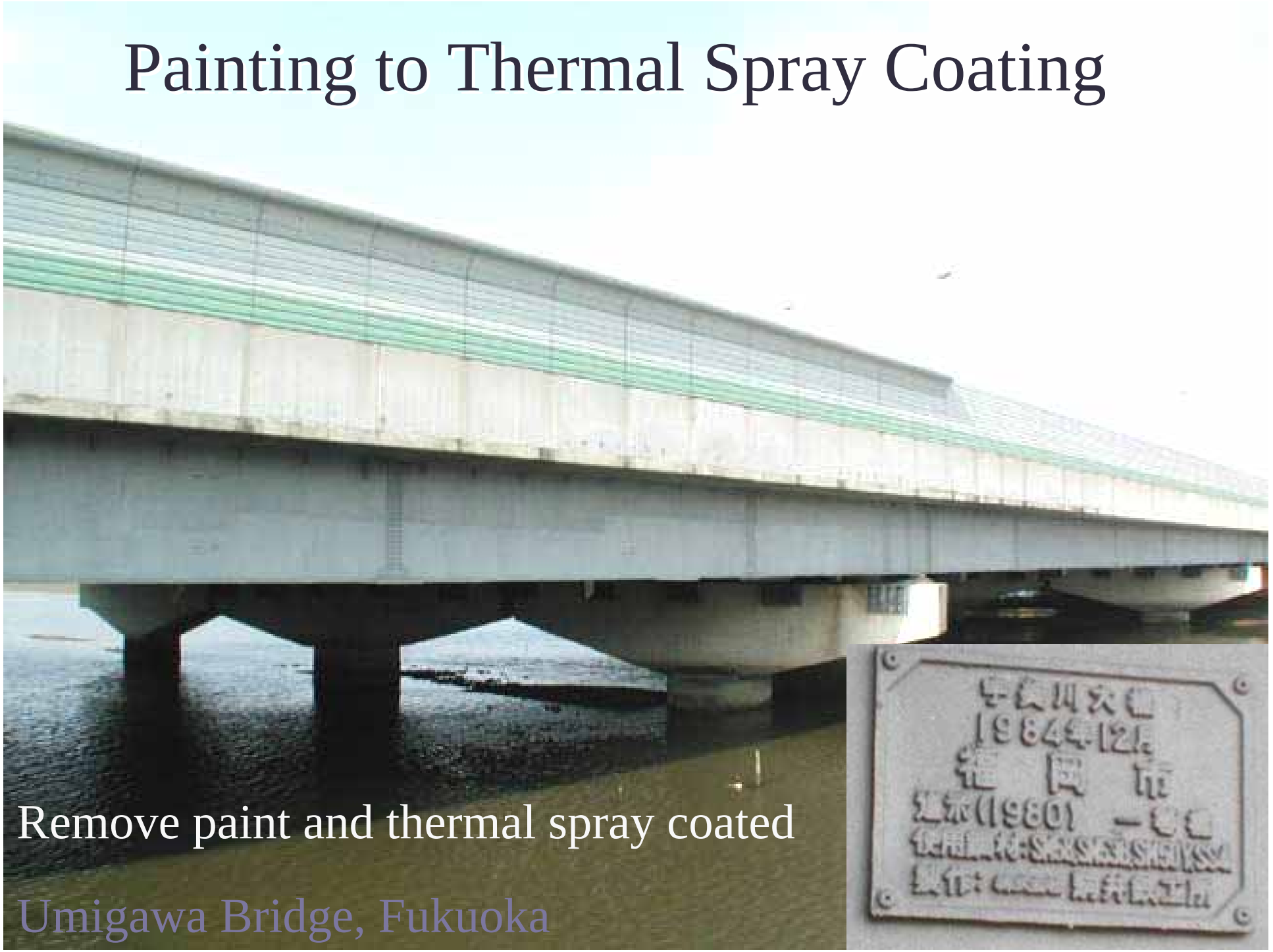
Thermal Spray Coating at Bolted Joints

Zinc-Aluminum Thermal Spray and Paint

Remove paint and thermal spray coated

Umigawa Bridge, Fukuoka

Painting to Thermal Spray Coating



Remove paint and thermal spray coated

Umigawa Bridge, Fukuoka

Partial Use of Thermal Spray Coating

Thermal spray coating at corroded panel points and floor beams.

Owari Ohashi Bridge, 1934

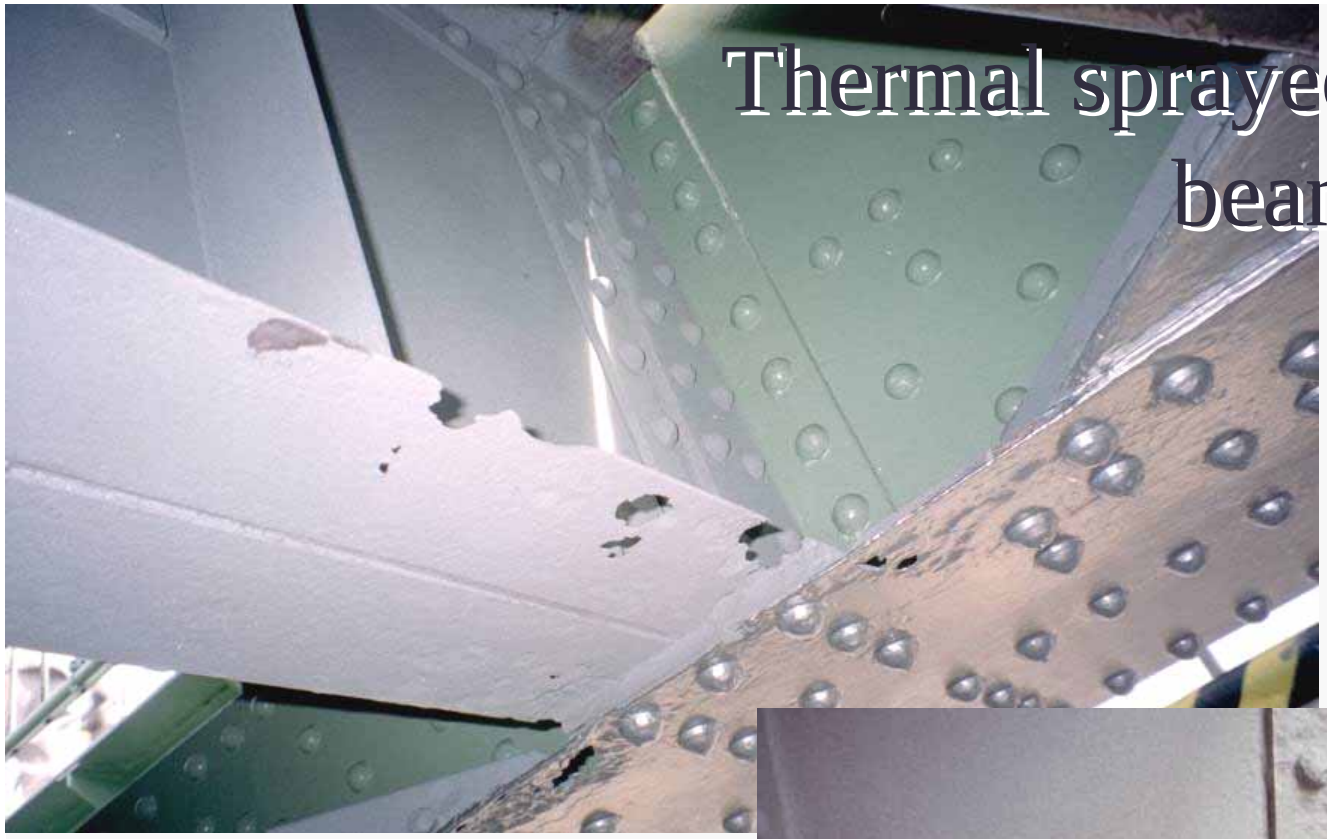
Sand blasting

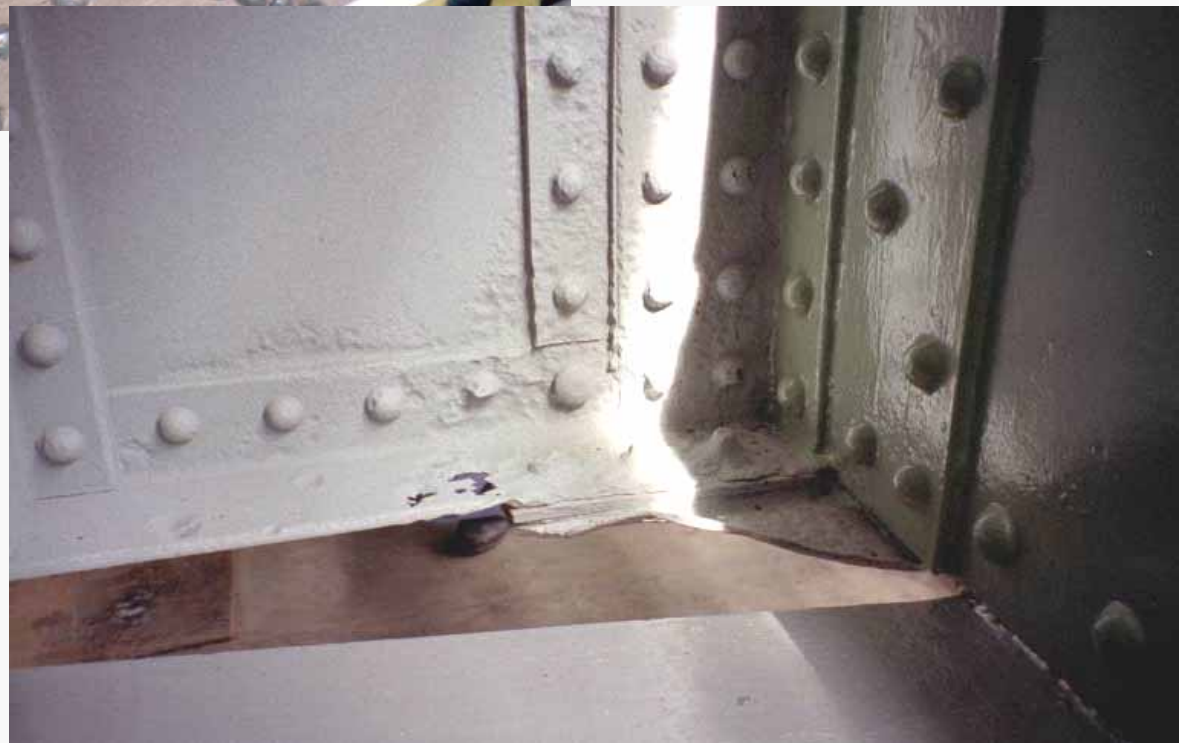
Surface treatment

Special Surface treatment, (MS system)

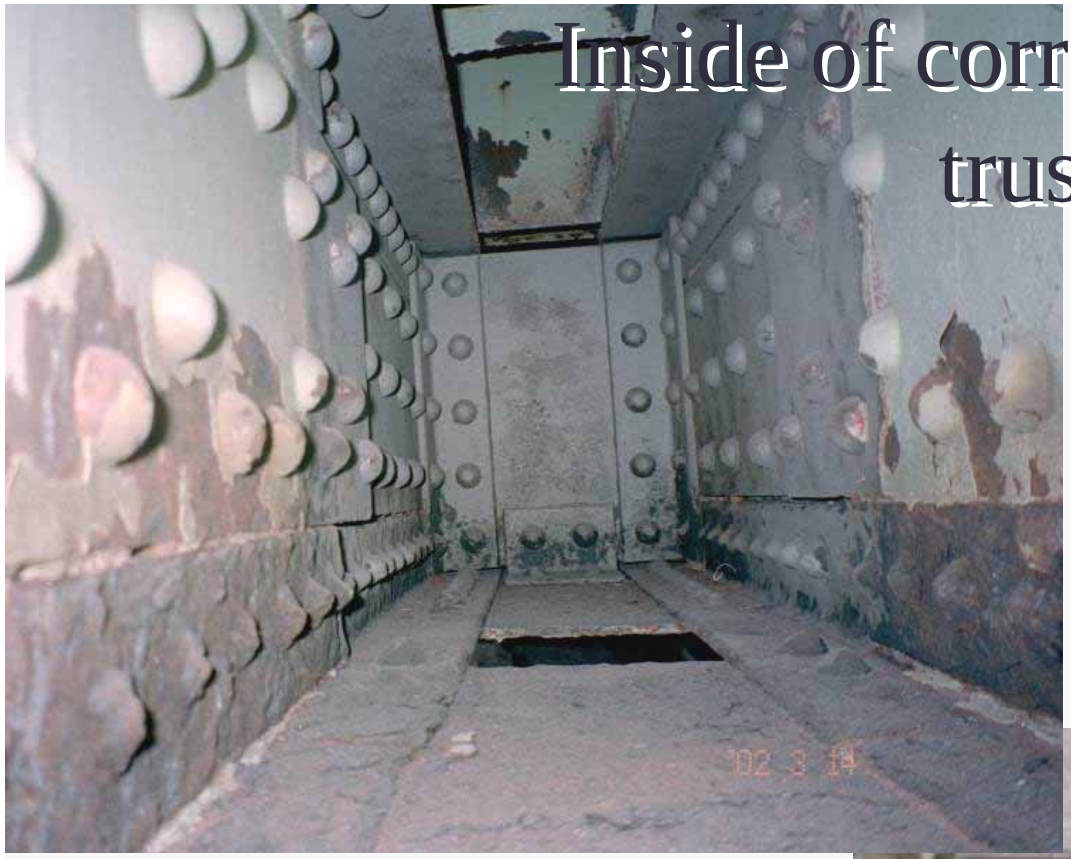
Metal Spray

Thermal sprayed area of floor beams

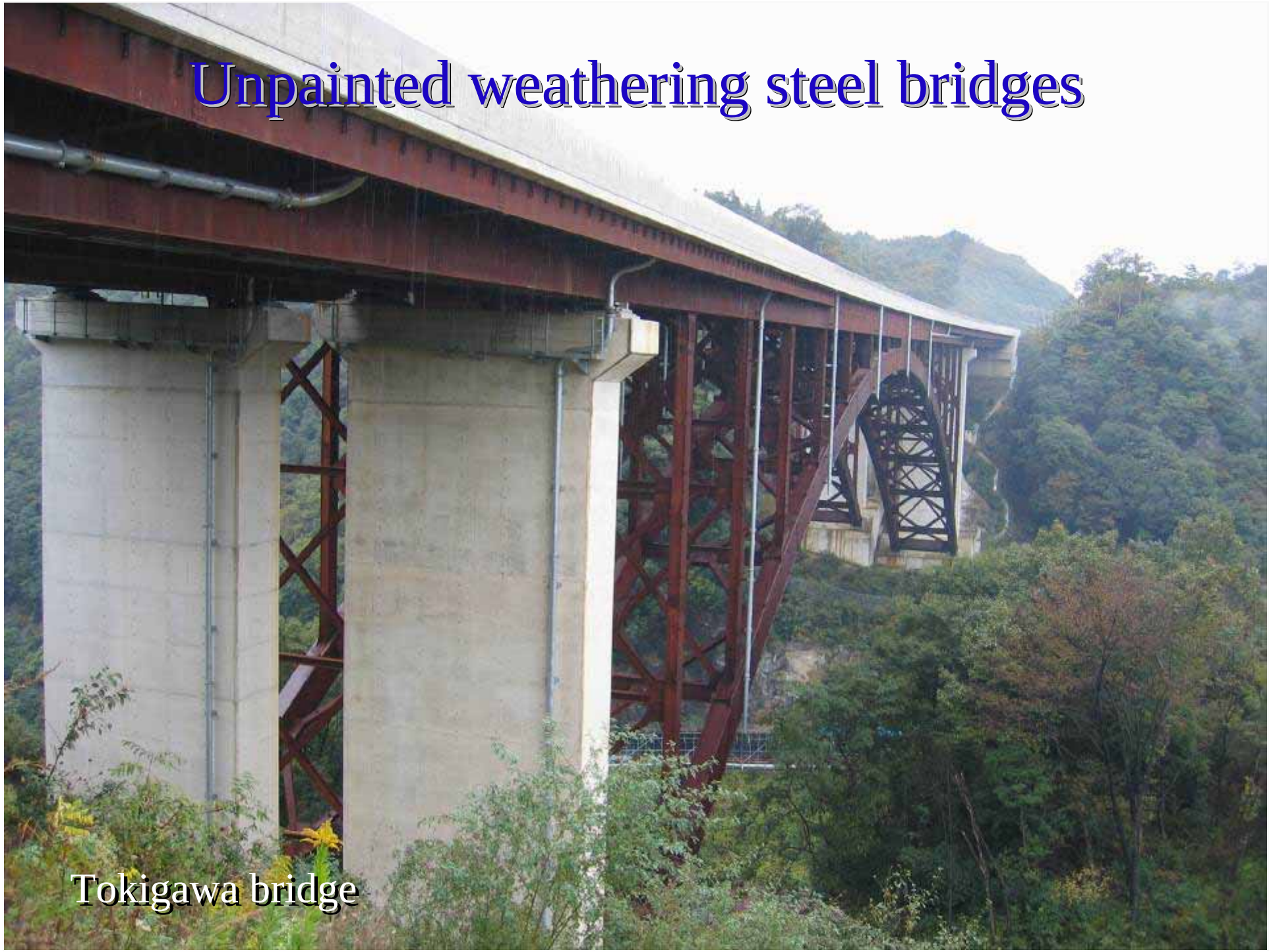




Inside of corroded lower chord of truss member



Unpainted weathering steel bridges



Tokigawa bridge

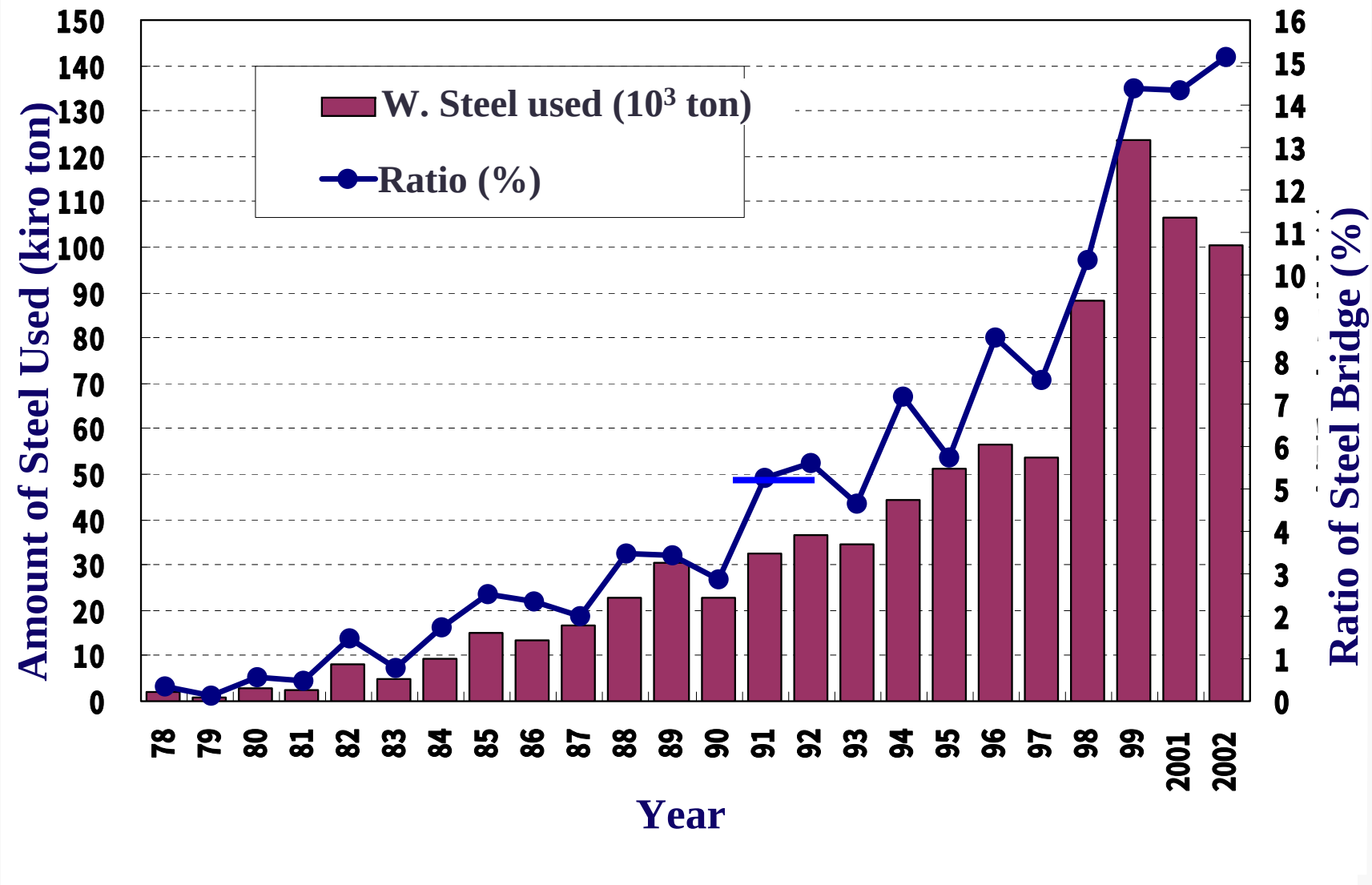
Unpainted weathering steel bridges

Toki Junction, Tokai Hokuriku expressway

Unpainted weathering steel bridges

Over bridge in Toki Junction

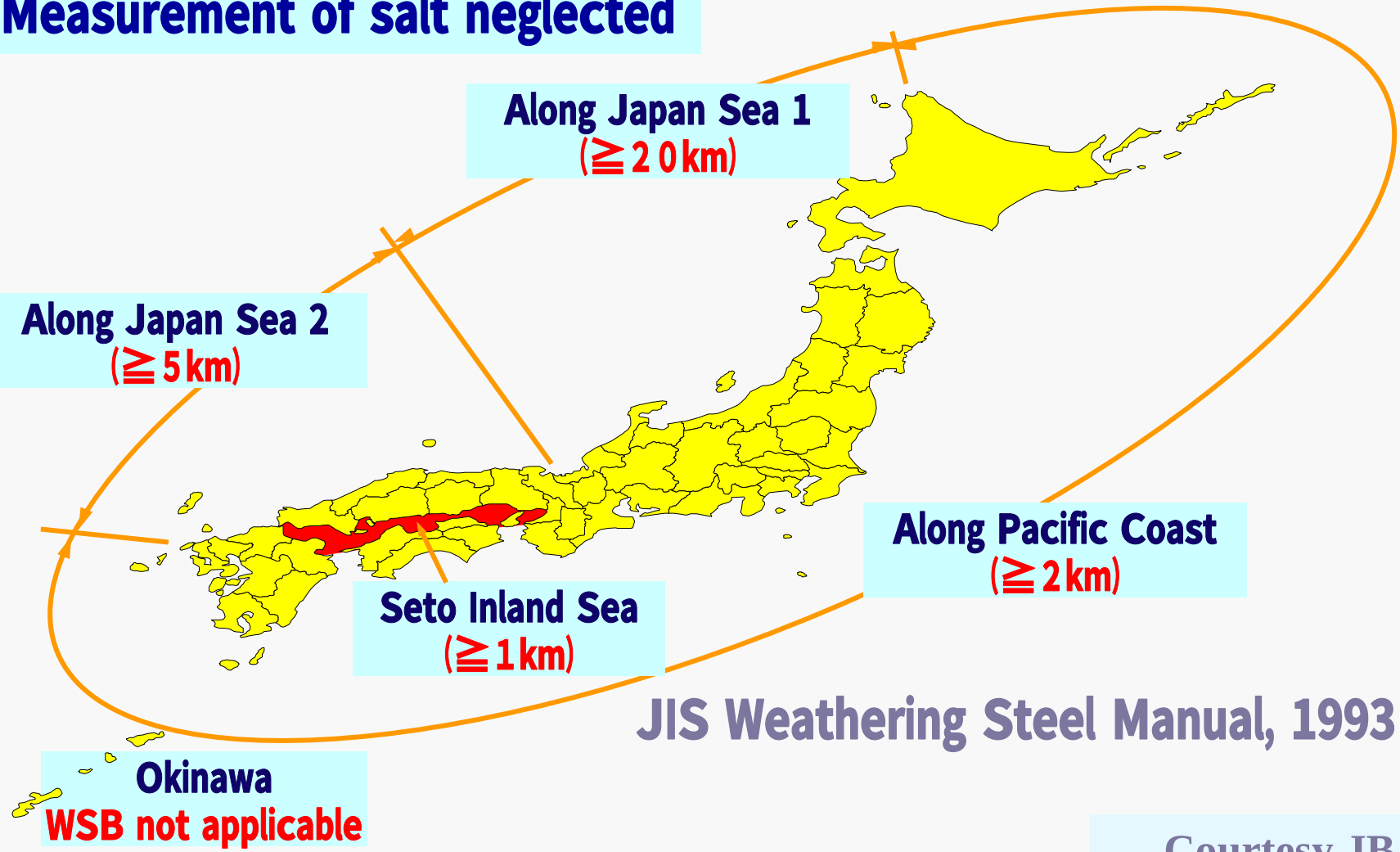
Trends in weathering steel bridges in Japan



Courtesy JBA

Appropriate Location of Weathering Steel Bridge

① Airborne salt ≦ 0.05 mdd
② Measurement of salt neglected

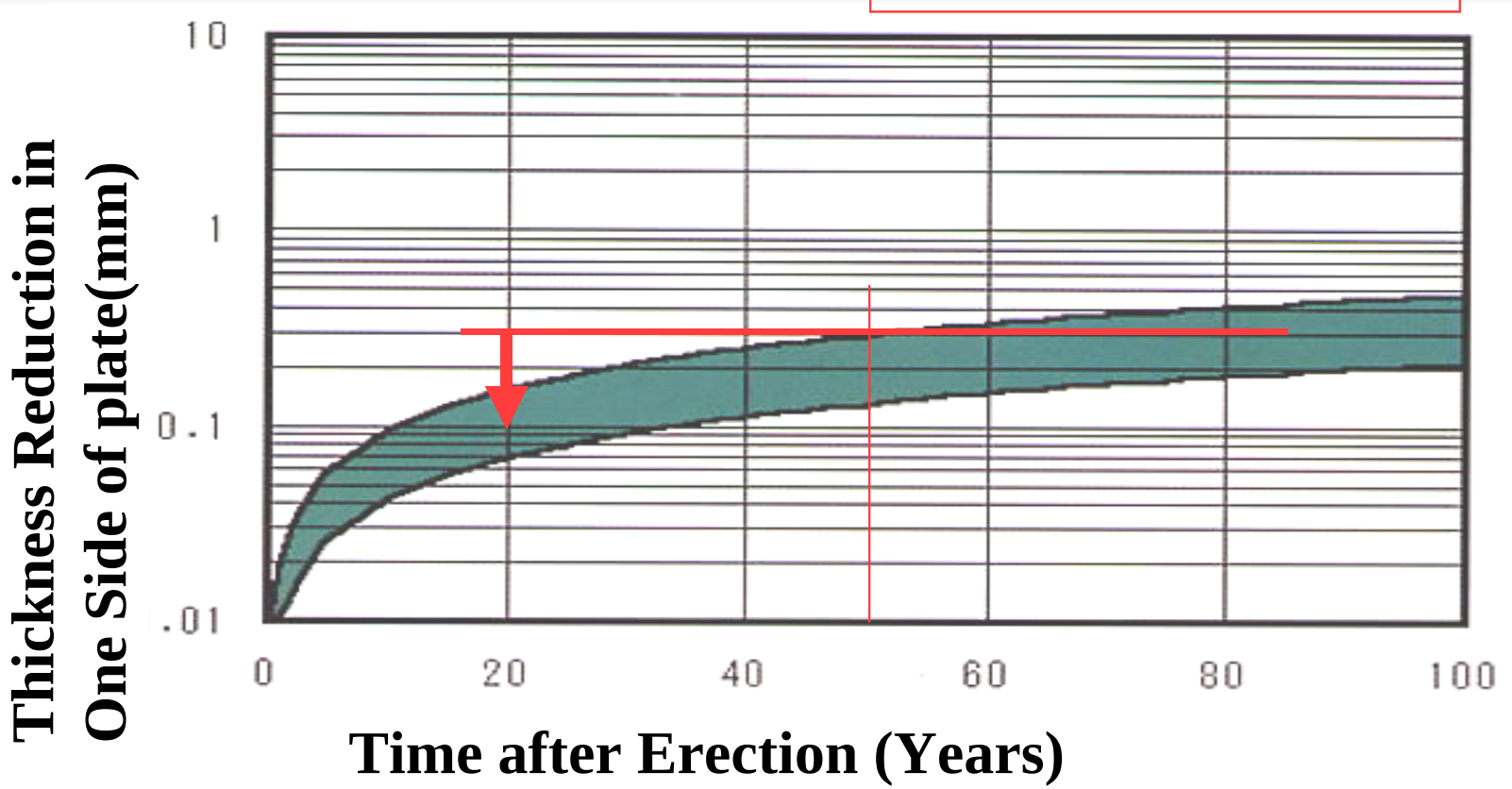


JIS Weathering Steel Manual, 1993

Courtesy JBA

Estimated corrosion of weathering steel

≦ 0.3 mm



Airborne Salt ≦ 0.05 mdd
($mg/dm^2/day$)

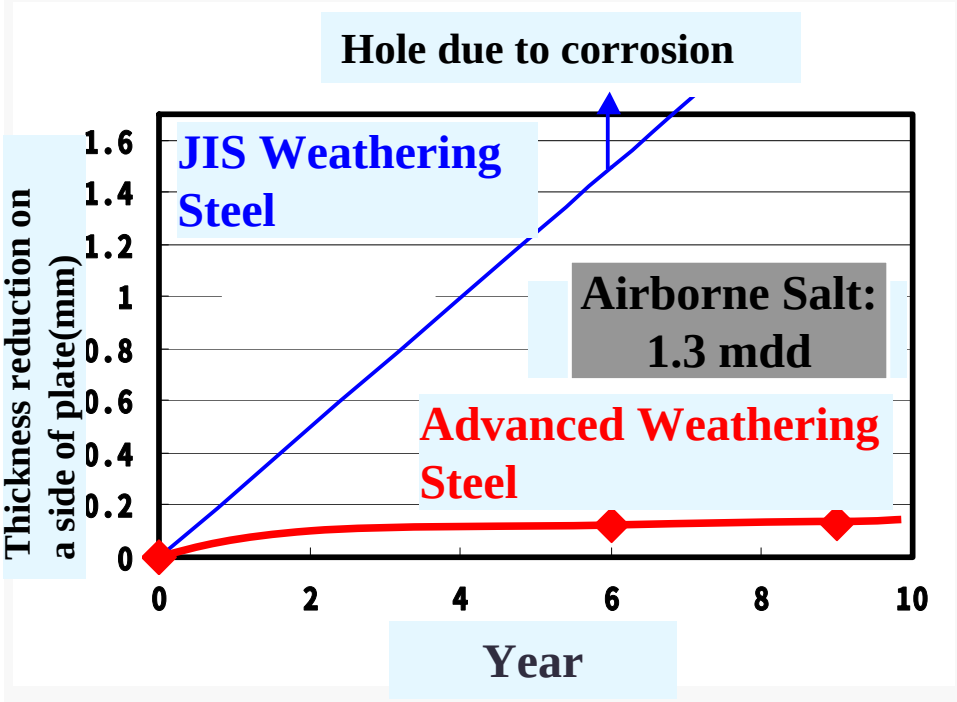
Courtesy JBA

Chemical composition of nickel-containing advanced weathering steel

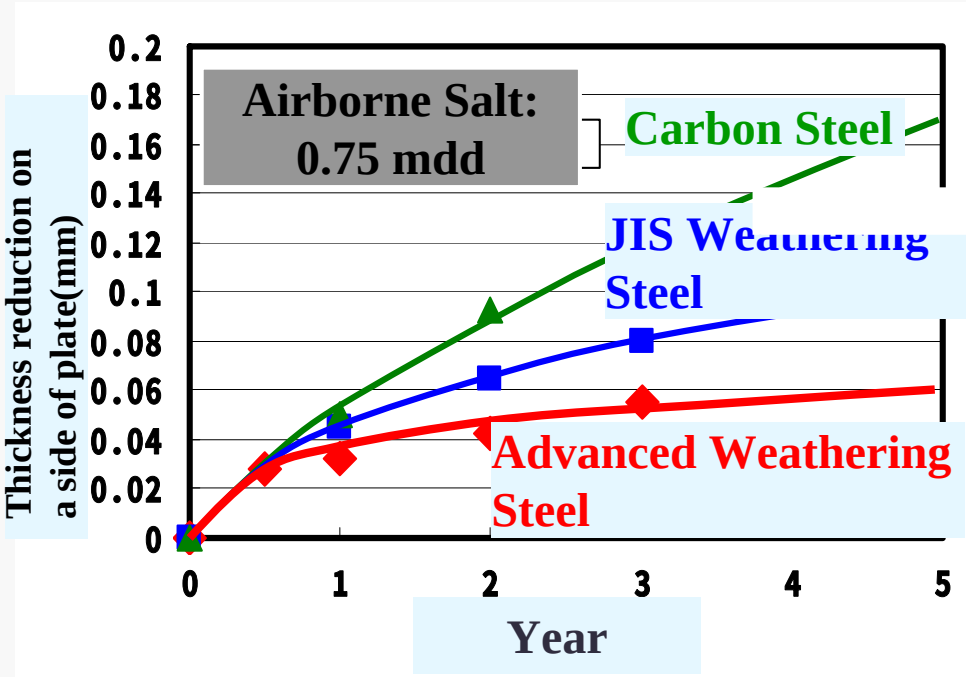
Type	Chemical Composition
A	0.3Cu-3Ni Type
B	1.5Ni-0.3Mo Type
B	Low C-0.3Cu-2.5Ni
C	0.3Cu-2Ni-0.5Cr-0.3Mo Type
D	1Cu-1Ni-0.05Ti Type
JIS Weathering Steel	Ni 0.05—0.3%

Courtesy JBA

Corrosion Rate of Advanced Weathering Steel



Example 1



Example 2

Courtesy JBA

JR Hokuriku Shinkansen

0.6 km from Japan Sea
3% Ni-Cu type weathering steel
(ex. SMA490W-Mod SMA570WQ-Mod)

Courtesy JRCC

Naharigawa Bridge, Tosa Kuroshio Railways

Ginagawa Bridge, Hokuriku, MLIT

Built in 2002

Courtesy JRCC